ROUTINE METEOROLOGICAL DATA PROCESSING

Purpose

This Air Quality Group procedure describes the routine meteorological data processing performed by the ESH-17 Meteorological Monitoring Project.

Scope

This procedure applies to meteorological data processing that is performed on a weekly, monthly, and yearly basis.

In this procedure

This procedure addresses the following major topics:

Hazard Control Plan

The hazard evaluation associated with this work is documented in HCP-ESH-17-Office Work.

Signatures

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Approved by: Terry Morgan, Quality Assurance Officer	Date: **8/26/99**
Work authorized by: Doug Stavert, ESH-17 Group Leader	Date: **8/28/99**

09/01/99

General information about this procedure

Attachments

This procedure has the following attachments:

Number	Attachment Title	No. of pages
1	MDM.out E-mail Message example	1
2	Meteorological Station Logbook entry example	1
3	Meteorological Data Edit File example	1
4	Daily Observation Sheet example	2
5	Distribution List for Meteorological Monthly Summaries example	1

History of revision

This table lists the revision history and effective dates of this procedure.

Revision	Date	Description Of Changes
0	03/31/98	New document.
1	8/30/99	Added new datalogger and HCP information.

Who requires training to this procedure?

The following personnel require training before implementing this procedure:

- Meteorology Team Data Analyst

Training method

The training method for this procedure is on-the-job training by a previously-trained individual and is documented in accordance with the procedure for training (ESH-17-024).

Prerequisites

In addition to training to this procedure, the following training is also required prior to performing this procedure:

- Knowledge of and experience with UNIX software.

General information, continued

Definitions specific to this procedure

15-minute data: Meteorological data collected every 15 minutes.

24-hour data: Daily summary values (maxima, minima, totals, and averages) for the 00 - 24 MST period.

Archive File: A file containing meteorological data that has been through the quality control process and is ready for permanent storage. Also used to refer to the file that contains a history of all editing commands for a station.

Circular File: A file containing the last 90 days of data collected for a station. Data must be copied from the circular file to an archive file to avoid overwriting and data loss.

Dependency: When one parameter is used to calculate the value of another parameter. Dependencies are used in editing.

Historical Archive File: A file containing selected 24-hour values taken from the TA-6 archive file to create the laarc archive file. The TA-54 24-hour values are used to create the wrarc archive file.

Listp: Custom printing script.

MDM.out: The code used to create and manage the binary files.

Stationid: An identification assigned to each meteorological station. Current stations are identified as TA-6, TA-16, TA-41, TA-49, TA-53, TA-54, TA-74, Pajarito Mountain, and North Community.

References

The following documents are referenced in this procedure:

- ESH-17-024, “Personnel Training”
- “User’s Guide to UNIX Software for ESH-17 Meteorological Operations” (pertinent software: MDM.out, qc.pro, monthly_summary.pro, as.pro, wi.pro, windrose.pro, wx_obs.pro, dl_check.pl)

Note

Actions specified within this procedure, unless preceded with “should” or “may,” are to be considered mandatory guidance (i.e., “shall”).

Weekly data processing

Overview

The code MDM.out (see "User's Guide to UNIX Software for ESH-17 Meteorological Operations," MDM.out section 2.2.1 "Binary File Edits") compares recent data with predetermined ranges for each variable. MDM.out replaces data outside of these ranges with the missing code, -999999.0, and sends e-mail regarding automatic edits to the meteorologist responsible for data quality control (see example e-mail in Attachment 1).

The instrument technician logs all activities that might affect data quality in a notebook. Data that are known to be bad are noted by station, date, time period, and variable in the Meteorological Station Logbook kept in the Meteorological Laboratory (TA-59-OH1-178).

Weekly, not later than Thursday, the meteorologist responsible for data quality control reviews all e-mail generated by MDM.out and visually inspects time series of all variables using the qc.pro Wave code (see "User's Guide to UNIX Software for ESH-17 Meteorological Operations," documentation for PV-Wave code qc.pro). Problems not detected by the range checking and any corrections to the automatic edits are noted in the logbook. Instructions from the meteorologists and instrument technician are the basis for the weekly processing as described below.

Steps to process data

To process data, perform the following steps:

Step	Action
1	Check the Meteorological Station Logbook for each station to see if there are any data edits recorded since the last data processing session (see Attachment 2).
2	Unpack datalogger files to run dl_check.pl for each station to check for missing data periods (example: unpack /data/dlog/stionid.dl_yyyy.z).
3	Execute dl_check.pl. Verify there are no data gaps or duplicate data. See dl_check.pl for details.
4	Execute MDM.out in an open window and make necessary edits (see "User's Guide to UNIX Software for ESH-17 Meteorological Operations," MDM.out section 2.2.1, "Binary File Edits").
5	Create an edit command file (example: stationidyyyy.edits).
6	Print edit command file by opening a second hpterm window (example: listp stationidyyyy.edits) and verify that all variables to be edited are entered and the day and time are correct.
7	Initial and date the meteorological station logbook when edits have been completed (see Attachment 2).

Weekly data processing, continued

Step	Action
8	Change group from /users to /met, because the archive edit command files are in the met group (example: newgrp met).
9	Append stationidyyyy.edits with the edit command archive file (example: cat stationidyyyy.edits>> /data/edits/stationid/stationidyyyy.edits) and verify the file was appended by adding the size of the files in Step 5 and comparing to the size of the edit command archive file appended. **Note**: Edit command files are archived in the event that the binary data files are destroyed. The data as well as the edits may be recovered.
10	Return to the window running MDM.out and update the archive files (see "User's Guide to UNIX Software for ESH-17 Meteorological Operations," MDM.out section 2.2.2, "Updating From Circular Files"). **Note**: Edits must be completed before update occurs.
11	Update laarc and wrarc files (see "User's Guide to UNIX Software for ESH-17 Meteorological Operations," MDM.out section 2.2.3, "Updating Historical Archives").
12	Verify that the data in the circular files have been moved to an archive file by using MDM.out and selecting choice number 3 from the "Utilities and Diagnostics" menu, then select number, 14 Data Availibity (r:AR_DATA_DIR & CI_DATA_DIR) (see "User's Guide to UNIX Software for ESH-17 Meteorological Operations," MDM.out section 2.2, "Testing and Diagnostics").

Monthly data processing

Overview

During the first week of each month, a monthly weather summary for the previous month is generated for the official Los Alamos weather station (currently at TA-6) and the station that represents the White Rock area (currently TA-54). These summaries are based on data stored in two special files called laarc (Los Alamos station) and wrarc (White Rock station). Most of the data in these files come from the TA-6 and TA-54 binary files, but information on snow and special weather observations come from other sources (see Attachment 4). The procedure outlined below explains how to update the larrc and wrarc files and use the updated files to create the monthly weather summary.

Steps to process data

To process data, perform the following steps:

Step	Action
1	Check the Meteorological Station Logbook for each station to verify that all edits have been completed for the month (see Attachment 2).
2	Create an archive edit command file using MDM.out and manually enter data for snow and trace amounts (see "User's Guide to UNIX Software for ESH-17 Meteorological Operations," MDM.out section 2.2.1, "Binary File Edits"). a) Zero snowfall and snow depth for the month. b) Insert -1 for days on which trace amounts of precipitation, snowfall and snow depth were observed (see the daily observation sheet, Attachment 4). c) Insert snowfall and snow depth data taken from daily observation sheet (Attachment 4).
3	Update laarc and wrarc archive files (see steps 8-10 in the previous chapter, *Weekly data processing*).
4	Update the wx_observation file. Open a text editor window and open /data/met_archive/wx_observation.txt and add daily observations recorded on daily observation sheet (Attachment 4). Examples of observations: fog, ice pellets, glaze, thunder, hail (see "User's Guide to UNIX Software for ESH-17 Meteorological Operations," wx_obs.pro).
5	Run monthly summary by opening an Xterm window and activating PV-Wave software (see monthly_summary.pro for details). Running monthly_summary.pro produces a "tiff," "lis," and "info" file.

Monthly data processing, continued

Step	Action
6	Create a GIF file from a TIFF file by opening a window and executing the following command: xv -rv mon_sum_xxxxx_mm-yyyy.tif (where xxxxx is laarc for Los Alamos archive or wrarc for White Rock archive and mm-yyyy is the number of the month and the year). An xv plot will appear. Move the cursor to xv plot and click the right mouse button. Return to the open window and type: gjet -og mon_sum_xxxxx_mm-yyyy.gif (see monthly_summary.pro for details).
7	Generate precipitation summary (see "User's Guide to UNIX Software for ESH-17 Meteorological Operations," mp from wi.pro for details).
8	Move GIF file to Wx_machine (example: cp mmmyy.gif/users/Gopher/gopherstuff/DATA/LANL_Met_Archives/monthsum/1999). Then modify the "html" file /users/gopher/gopherstuff/DATA/html/Welcome.html. Modify /users/gopher/gopherstuff/DATA/html/monthlysummaries.html to include the recent monthly summary and revised date. Changes to these files will modify the Weather Machine page http://weather.lanl.gov.
9	Run extremes for Wx_machine by opening an Xterm window and running wave and executing the following command: extremes, 'xxxxx',/html, file='XXExtremes.html' (where XX is LA or WR and xxxxx is laarc for Los Alamos archive or wrarc for White Rock archive). Exit wave and Xterm window. Modify the date of the revised files to the current date by using ved/vi XXExtremes.html. Move the files XXExtremes.html to /users/gopher/gopherstuff/DATA/html/XXExtremes (example: mv XXExtremes.html /users/gopher/gopherstuff/DATA/html/XXExtremes).

Year end data processing

Overview

During the first two weeks of January, the following data processing is performed for the previous year:

- A graphical annual summary is generated that summarizes the annual temperature range, precipitation, and snowfall.
- wind roses and a precipitation summary are generated for the Environmental Surveillance Report.
- new archive station files are created to store data from the station files.
- archive files for the previous year are converted to text files and moved to permanent storage in the Common File System.

Steps to process data

To process data, perform the following steps:

Step	Action
1	Update station archive files (follow steps 8-10 of the chapter *Weekly data processing*), including laarc and wrarc.
2	Run the monthly summary (follow steps 1 - 9 of the chapter *Monthly data processing*)
3	Run the annual summary for Los Alamos using TA-6 (see "User's Guide to UNIX Software for ESH-17 Meteorological Operations," as.pro for details).
4	Put GIF images on the Wx_machine (follow Step 8 of the chapter *Monthly data processing*).
5	Run extremes for Wx_machine (see "User's Guide to UNIX Software for ESH-17 Meteorological Operations," wi.pro for details).
6	Create new station archive and circular files (see "User's Guide to UNIX Software for ESH-17 Meteorological Operations," MDM.out section 2.3.3, "A Circular File").
7	Create text backup files (see "User's Guide to UNIX Software for ESH-17 Meteorological Operations," MDM.out section 2.3.6, "Text Backup Files"). Transfer to CFS (Common File System) for storage. **Note**: Text files are moved here in case we move to a different platform the text files already exist.
8	Generate wind roses and add to Wx_machine (see "User's Guide to UNIX Software for ESH-17 Meteorological Operations," windrose.pro for details).

Records resulting from this procedure

Records

The following records are created as a result of this procedure and are available in electronic form on the LANL Weather Machine. Paper copies are maintained at TA-59, Bldg. 0001 for local use. These records may be re-created from original data.

- Los Alamos Monthly Summary
- Los Alamos Annual Weather Summary
- White Rock Monthly Summary
- White Rock Annual Weather Summary
- Wind Rose Maps for day, night, and total
- Precipitation Summary

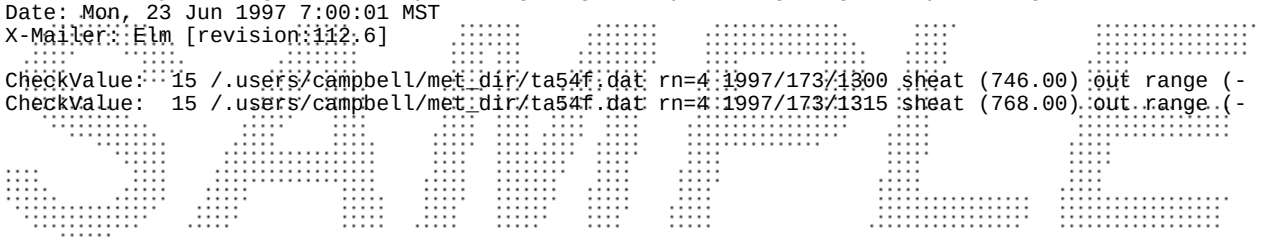
Data editing commands are stored electronically in a file in the LANL Common File System.

MDM.out E-mail Message Example

```
Jun 23  07:01 1997    /tmp/print.6111 Page 1

From campbell@sibyl.lanl.gov Mon Jun 23 07:00:02  MST 1997
Received:  by sibyl.lanl.gov
        (1.40.112.12/16.2)  id AA060554401;  Mon, 23 Jun 1997 07:00:01 -0700
From: campbell@sibyl.lanl.gov
Return-Path: <campbell@sibyl.lanl.gov>
Subject: something found in mdm.output
To: holt@sibyl.lanl.gov, wao@sibyl.lanl.gov, jab@sibyl.lanl.gov, gls@sibyl.lanl.gov
Date: Mon, 23 Jun 1997 7:00:01 MST
X-Mailer: Elm [revision:112.6]

CheckValue:  15 /.users/campbell/met_dir/ta54f.dat rn=4 1997/173/1300 sheat (746.00) out range (-
CheckValue:  15 /.users/campbell/met_dir/ta54f.dat rn=4 1997/173/1315 sheat (768.00) out range (-
```



Meteorological Station Logbook Entry Example

Meteorological Data Edit File Example

```
ta6 15 circular 199701070700 199701071730 swdn,netrad replace *
ta6 15 circular 199701080700 199701081730 swdn,netrad replace *
ta6 15 circular 199701090700 199701091000 swdn,netrad replace *
ta6 24 circular 19970070000 19970090000 swedn,nete replace *
ta6 15 circular 199701150715 199701151215 swdn,netrad replace *
ta6 24 circular 199701150000 199701150000 swedn,nete replace *
ta6 15 circular 199701182100 199701211430 lwdn,netrad replace *
ta6 24 circular 199701180000 199701210000 lwedn,nete replace *
ta6 15 circular 199701211430 199701211445 lwdn,netrad replace *
ta6 15 circular 199701261415 199701261415 lheat replace *
ta6 15 circular 199701311000 199701311430
spd1,spd2,spd3,spd4,sdspd1,sdspd2,sdspd3,sdspd4,dir1,dir2,dir3,dir4,sddir1,sddir2,sddir3,sddir4,w
1,w2,w3,w4,sdw1,sdw2,sdw3,sdw4,temp1,temp2,temp3,temp4,sheat,lheat,fvel2 replace *
ta6 24 circular 199701310000 199701310000
avgspd1,avgspd2,avgspd3,avgspd4,mxgst1,dirgst1,tgst1,mxgst2,dirgst2,tgst2,mxgst3,dirgst3,tgst3,mx
gst4,dirgst4,tgst4,mx1gst,dir1gst,t1gst,sheate,lheate replace *
ta6 24 circular 199702050000 199702050000
avgspd1,avgspd2,avgspd3,avgspd4,avgrh,mxdewp,mndewp,avgdewp,swedn,sweup,lwedn,lweup,nete,mnpress
replace *
ta6 15 circular 199702280800 199702281215 swdn,netrad replace *
ta6 24 circular 199702280000 199702280000 swedn,nete replace *
ta6 15 circular 199703141115 199703141115 press,sheat replace *
ta6 15 circular 199703141200 199703141200 stemp replace *
ta6 24 circular 199703140000 199703140000 mnpress replace *
ta6 15 circular 199703270845 199703270845 lheat replace *
ta6 15 circular 199704040415 199704040645 sddir1,spd1,dir1,sdspd1,fvel2 replace *
ta6 15 circular 199704040500 199704040730 spd2,sdspd2,dir2,sddir2 replace *
ta6 24 circular 199704040000 199704040000 avgspd1,avgspd2 replace *
ta6 15 circular 199704040100 199704040900 sheat,lheat,fvel2,w1,w2,sdw1,sdw2 replace *
ta6 15 circular 199704040100 199704041230 w3,w4,sdw3,sdw4 replace *
ta6 15 circular 199704120800 199704120800 lheat replace *
ta6 24 circular 199704120000 199704120000 lheate replace *
ta6 15 circular 199704130500 199704130500 lheat replace *
ta6 15 circular 199704130800 199704130800 lheat replace *
ta6 15 circular 199704142130 199704142130 sheat replace *
ta6 15 circular 199704140945 199704141345
spd1,spd2,spd3,spd4,sdspd1,sdspd2,sdspd3,sdspd4,dir1,dir2,dir3,dir4,sddir1,sddir2,sddir3,sddir4,w
1,w2,w3,w4,sdw1,sdw2,sdw3,sdw4,temp1,temp2,temp3,temp4,lheat,sheat,fvel2 replace *
ta6 24 circular 199704140000 199704140000
avgspd1,avgspd2,avgspd3,avgspd4,mxgst1,mxgst2,mxgst3,mxgst4,tgst1,tgst2,tgst3,tgst4,dirgst1,dirgs
t2,dirgst3,dirgst4,mx1gst,dir1gst,t1gst replace *
ta6 15 circular 199704242000 199704242345 spd2,sdspd2,dir2,sddir2 replace *
ta6 15 circular 199704241615 199704241630 spd1,sdspd1,fvel2,dir1,sddir1 replace *
ta6 15 circular 199704242000 199704242030 spd1,sdspd1,fvel2,dir1,sddir1 replace *
ta6 15 circular 199704241530 199704242045 w2,w3,w4,sdw2,sdw3,sdw4 replace *
ta6 15 circular 199704241600 199704241630 w1,sdw1,sheat,lheat,fvel2 replace *
ta6 15 circular 199705071130 199705071130 lheat replace *
ta6 15 circular 199705131030 199705131100 temp1,temp2,temp3,temp4,sheat replace *
ta6  15 circular 199705131030 199705131100
spd1,spd2,spd3,spd4,sdspd1,sdspd2,sdspd3,sdspd4,dir1,dir2,dir3,dir4,sddir1,sddir2,sddir3,sddir4,w
1,w2,w3,w4,sdw1,sdw2,fvel2,lheat,sheat,sdw3,sdw4 replace *
ta6 15 circular 199705131030 199705140000 fvel2,sheat,lheat replace *
ta6 15 circular 199705140015 199705150000 sheat,lheat,fvel2 replace *
ta6 24 circular 199705140000 199705140000 sheate,lheate replace *
ta6 15 circular 199705150900 199705151230
spd1,spd2,spd3,spd4,sdspd1,sdspd2,sdspd3,sdspd4,dir1,dir2,dir3,dir4,sddir1,sddir2,sddir3,sddir4,w
1,w2,w3,w4,sdw1,sdw2,sdw3,sdw4,temp1,temp2,temp3,temp4,fvel2,lheat,sheat replace *
ta6 15 circular 199705151345 199705151415
spd1,spd2,spd3,spd4,sdspd1,sdspd2,sdspd3,sdspd4,dir1,dir2,dir3,dir4,sddir1,sddir2,sddir3,sddir4,w
1,w2,w3,w4,sdw1,sdw2,sdw3,sdw4,temp1,temp2,temp3,temp4,fvel2,lheat,sheat replace *
ta6 15 circular 199705150015 199705160000 sheat,lheat,fvel2 replace *
ta6 24 circular 199705150000 199705150000
avgspd1,avgspd2,avgspd3,avgspd4,mxgst1,dirgst1,tgst1,mxgst2,dirgst2,tgst2,mxgst3,dirgst3,tgst3,mx
gst4,dirgst4,tgst4,mx1gst,dir1gst,t1gst,sheate,lheate replace *
ta6 15 circular 199705160015 199705161100 lheat replace *
ta6 24 circular 199705160000 199705160000 lheate replace *
ta6 15 circular 199705220545 199705230530 swup,lwup,netrad replace *
ta6 24 circular 199705220000 199705230000 sweup,lweup,nete replace *
ta6 15 circular 199705230730 199705231515 all replace *
ta6 15 circular 199705230730 199705231515 precip replace 0.00
```

Daily Observation Sheet Example

Distribution List for Meteorological Monthly Summaries

(Example current as of procedure approval date)

PLOT & SUMMARY

Los Alamos Monitor
Attn: Charmian Schaller
265 DP Road
Los Alamos, NM 87544

KRSN Radio Station
Attn: Tom Trowbridge
400 North Mesa Road
Los Alamos, NM 87544

Steve Sandoval C177

OBS & PLOTS

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A199 Bob Westervelt

Melissa Coronado K490

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A199 Kathy Davis

Melissa Coronado K490

PRECIP CHART

Brad Wilcox J495

Melissa Coronado K490

Alex Puglisi K497

Melissa Coronado K490

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PLOTS ONLY

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J576 Fred Edeskuty

Melissa Coronado K490

C931 Paul Smith

Melissa Coronado K490

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